From Alfred to Aalborg: Counting Constraints and Strengthening Glasses

Invited Talk

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Professor Arun Varshneya's research within glass science and technology has covered a variety of physical properties and glass making and processing techniques. This includes his pioneering work on glass mechanical properties, which overlaps with his role as president for Saxon Glass Technologies, a company that produces a chemically-strengthened glass injector device (EpiPen). Building on Prof. Varshneya's ideas and results in the field, this talk intends to highlight some of our own research on glass strengthening through post-processing and/or topological optimization of the glass network. First, we discuss the use of topological constraint theory to understand and predict the hardness and indentation response of glasses. Second, we demonstrate the unique effects of pressure and thermal history on the strengthening of aluminosilicate glasses through ion exchange. Third, we highlight the importance of understanding glass structure and its response to densification for tailoring the mechanical properties. Specifically, we discuss how certain structural motifs, such as trigonal boron units, can lead to effective chemical strengthening, yet optimal intrinsic damage resistance.